Super Mileage Challenge: Combining Education and Fun!

By Jim Thompson and Mike Fitzgerald

The Super Mileage Challenge teaches students to research, design, and construct futuristic vehicles while applying advanced topics in math, science, technology, and engineering.

Super Mileage participants.

Introduction

With the rising price of fuel and increased concerns for the environment, achieving maximum gas mileage continues to be a very important topic. Today, in an exciting student competition, Indiana students seek solutions by applying technology, innovation, design, and engineering. IMSTEA, the organization sponsoring the event, is a non-profit, all-volunteer organization dedicated to improving the mathematics, science, and technological literacy and competency of all Hoosiers. It was founded in 1990 and continues to pursue this goal today.

Beginning in 1996, key leaders in Indiana business, education, and industry, along with the Department of Education and the Indiana Math Science Technology Education Alliance recognized that creating an event that would showcase true integration of mathematics, science, and technology could make learning more relevant to the lives of students. The result is the highly successful Indiana Super Mileage Challenge.

The SMC is a high school competition providing students with the unique opportunity to combine theoretical aspects of mathematics, science, and technology with practical experience in the design, engineering, fabrication, and testing of an actual vehicle. For the past 11 years, students from across Indiana have been "challenged" by the SMC. They work throughout the school year to design, build, and improve vehicles. They then test the prototypes in competition each year at the NHRA's O'Reilly Raceway Park oval. This highly competitive event features innovative student solutions for achieving optimum mpg. Student teams design a one-person, fuel-efficient car powered by a single cylinder, four-cycle engine. The 2006 Unlimited Class Champion is William Henry Harrison High School, of Lafayette, Indiana whose team achieved 1060.30 mpg. The

Stock Class Champion was Mater Dei High School of Evansville, Indiana with 1241.76 mpg.

It All Begins in the Fall

Each year the SMC season begins with a letter of intent to participate that is sent to schools across the state. The responding schools are sent a copy of SMC rules and directions to the IMSTEA website at www.imstea.org. They are also offered guidance (especially needed by new teams) on how to get started. Finally, the schools are provided with the deadlines for submission of design proposals, the tentative date of the event, and any other necessary technical support that may be needed.

Often, a new team may want to visit an experienced team near their school for help. This is often the best way to start. A mentor team can provide much support. New teams often learn that guidance and assistance from mentors can be very valuable in building a successful entry.

Schools may have up to two entries each year, one in the stock class and one in the unlimited class. The stock class is based on engines provided by Briggs & Stratton Corporation. The engines are then sealed by IMSTEA officials. The unlimited class allows schools to modify the engine as long as it meets certain specifications. IMSTEA rules governing the cars and allowable modifications are provided in the rules package sent to each school. Many schools compete with both a stock-class vehicle and an unlimited-class vehicle. It is important to note that a school may not elect to enter into the unlimited class until after they have successfully competed in the stock class for one year.

Working Through the Winter

After schools have elected to participate, the portfolio season starts during the fall and the early winter months. Teams begin the design, marketing, and construction of their vehicles. Some schools do their work as part of their curriculum, whereas most conduct the work as a co-curricular or club activity. Students work to learn the rules, gain sponsorships, research, locate parts, and learn how to design in CAD or 3-D CAD programs, and most importantly, how to document their work through a design proposal.

The design portfolios/proposals serve two purposes. First, the portfolios provide the necessary information and documentation needed by the IMSTEA competition committee in order to determine that the vehicle design conforms to the rules. Second, the design proposal ensures that the entry is a result of a genuine design effort by teams. During the winter months, the teams design and construct many of the basic systems and subsystems. The design proposal requires that the student teams document the following:

- Vehicle design concept
- Frame/chassis
- Body
- Drive train
- Braking system
- Steering system
- Safety systems
- Aerodynamics
- Cornering forces
- Braking distance calculations
- Rolling friction calculation
- Performance prediction
- Accessories and instrumentation
- Cost estimate/bill of materials

Portfolio Review

In mid winter the IMSTEA Executive Competition Committee meets to review the portfolios. The team, representing business, industry, and education, studies each portfolio to determine if the conceptual design meets the minimum requirements of the competition. Those proposals meeting the requirements are approved as written or approved pending submittal of clarification in questionable areas.

The reviewing team recognizes that the proposals are for a design concept and that often the concept may not reflect the vehicle as it is actually built. The SMC rules require teams to present documentation of changes from the original concept at the time of technical inspection. The more experienced teams often begin construction of their vehicles prior to submitting their portfolios since the rules do not change significantly from year to year. Technical inspection insures that the teams are in compliance with the rules prior to participation in the event at Indianapolis O'Reilly Raceway Park.

During the portfolio review, the most prestigious awards of Best Integration of Math, Science, and Technology and the Best Design Proposal are determined. IMSTEA's intent since the beginning has been to emphasize what the students learn as much as what mileage their team achieves. Often the teams with the best mpg are also the teams with the best design portfolios. The teams finish the winter months by preparing for technical inspection, which is held the day before the event at Vincennes University's Aviation Technology hanger at the Indianapolis International Airport.

Technical Inspection

The day before the event, participating schools present their cars for a thorough technical inspection to verify conformance with the rules of the competition and to insure the vehicle is safe for operation on the track. For the past two years, Vincennes University has hosted this part of the competition and provided a dinner for the participants. Vincennes University is also a major financial sponsor for the Super Mileage Challenge. Items inspected include:

- Braking system – for ability to stop the car in the required distance.
- Stability – to test the ability of the car to withstand the banking at the track.
- Emergency exit – to insure the driver can exit the car quickly in the event of an accident.
- Safety equipment – mirrors, fire extinguisher, ventilation, kill switches, etc.
- Turning radius – to insure the car can maneuver properly.
- Helmets – for conformance to national standards.
- Conformance to rules – frame and body construction, engine modifications, steering system, etc.

Cars successfully completing this inspection are given a sticker certifying that they meet technical and safety standards. No car is allowed on the track without this sticker. For the past two years, Vincennes University has provided staff from the school of technology and the aviation technology center for the technical inspection.

Race Day

Competition starts early at Indianapolis O'Reilly Raceway Park. Drivers and crew chiefs must attend a mandatory safety meeting at 7:30 a.m., and the track is opened for runs at 8:00 a.m. Each run lasts 10 laps at an average of 15 miles per hour or higher. Most cars try to come as close to the minimum 15 mph speed as possible. Fuel tanks are weighed before and after each run, and the weight difference is used to calculate the mileage. Teams may make as many runs as they wish during the day, and the best three attempts are averaged for their official score.

In 2006, 49 schools submitted entries for the challenge, and 38 schools brought 45 cars to the event. The field included 35 Indiana high schools, one high school from Illinois, and two college entries. The college entries were not eligible for awards. There were 27 cars in the stock class and 18 in the unlimited class. Eleven schools created cars for both classes. Awards were given to the team with the best score in the race as well as for best integration of mathematics, science, and technology into the design and construction of the vehicle, best design, craftsmanship, sportsmanship, teamwork, and closest to estimated performance.

Conclusions

Each year the teachers and students rate their participation in the Super Mileage Challenge as one of the best learning experiences of their high school years. Alumni of this event often go on to pursue engineering, technical, or scientific degrees in college. The skills that students gain through participating in the Super Mileage Challenge are hard to measure. Not only do students learn how to apply math, science, technology, and engineering, they also learn teamwork, problem solving, and leadership skills. The IMSTEA Super Mileage Challenge helps aim students today for the careers and challenges of tomorrow.

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Web Resources

- Indiana Math Science Technology Education Alliance Web Page www.imstea.org
- 2006 IMSTEA SMC Slide Show www.aviationtechcenter.com/imstea.htm
- 2006 IMSTEA Super Mileage Challenge Results www.doe.state.in.us/octe/technologyed/pdf/IMSTEA%20RESULTS.pdf
- IMSTEA Super Mileage Challenge www.doe.state.in.us/octe/technologyed/SuperMileageChallenge.html
- Senator Richard G. Lugar, United States Senate IMSTEA SMC letter www.doe.state.in.us/octe/technologyed/pdf/SMClugar.pdf

School Website Resources

- Winamac High School: www.epulaski.k12.in.us/tech/hs/mileage.htm
- Mishawaka High School: www.mishawaka.k12.in.us/mhs_files/Departments/technology/MHSengineering/index.htm
- Albany Area Schools: www.albany.k12.mn.us/supermileage.html
- Bosse High School: http://bhsrunner0.tripod.com/id5.html
- Delta High School: www.delcomschools.org/dhs/SuperMileage/super_mileage.htm
- Ensweiler Academy Super Mileage Challenge: www.khwisdom.com/scienceclass/page8.html
- Mishawaka High School: mhsengineering.com/2003MPGvehicle/config.htm

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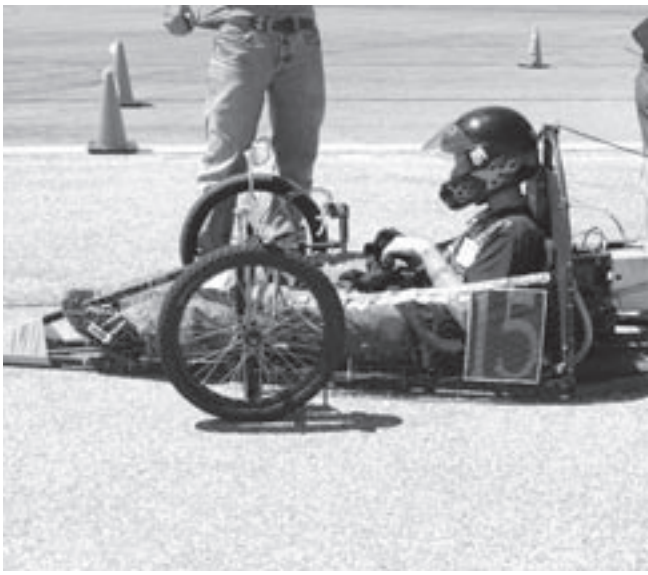

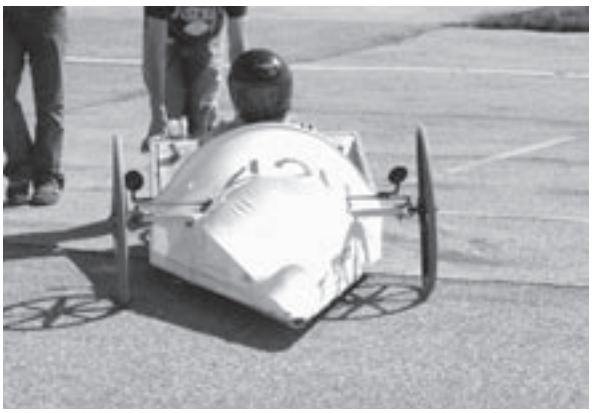


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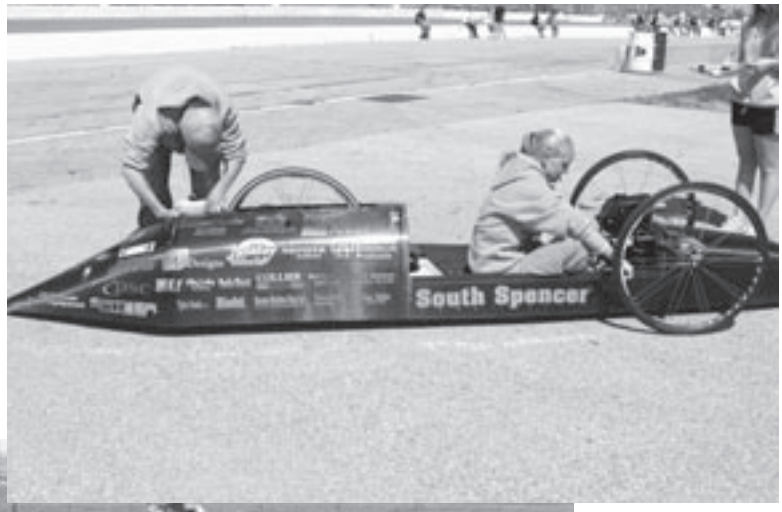
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